

FCC Test Report

FCC ID : 2AFVRCM-DONGLE01

Equipment : Bluetooth transmitter-receiver

Model No. : CM-DONGLE01

Brand Name : Cooler Master

Applicant : Cooler Master Technology Inc.

Address : 8F., No. 788-1, Zhongzheng Rd., Zhonghe

Dist., New Taipei City 23586, Taiwan (R.O.C.)

Manufacturer : Cooler Master Technology Inc.

Address : 8F., No. 788-1, Zhongzheng Rd., Zhonghe

Dist., New Taipei City 23586, Taiwan (R.O.C.)

Standard : 47 CFR FCC Part 15.247

Received Date : Sep. 17, 2015

Tested Date : Oct. 08 ~ Oct. 28, 2015

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:

Gary Chang / Manager





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Release Record

Report No.	Version	Description	Issued Date
FR591701AD	Rev. 01	Initial issue	Nov. 30, 2015

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Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.159MHz 49.88 (Margin -15.64dB) - QP	Pass
15.247(d)	Radiated Emissions	[dBuV/m at 3m]: 797.27MHz	Pass
15.209	Italialed Lillissions	41.51 (Margin -4.49dB) - PK	r ass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 5.63	Pass
15.247(a)(1)(iii)	Number of Hopping Channels	Meet the requirement of limit	Pass
15.247(a)(1)	Hopping Channel Separation	Meet the requirement of limit	Pass
15.247(a)(1)(iii)	Dwell Time	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

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1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information							
Frequency Range (MHz)	Channel Number	Data Rate					
2400-2483.5	BR	2402-2480	0-78 [79]	1 Mbps			
2400-2483.5	EDR	2402-2480	0-78 [79]	2 Mbps			
2400-2483.5	EDR	2402-2480	0-78 [79]	3 Mbps			

Note 1: Bluetooth BR uses a GFSK.

Note 2: Bluetooth EDR uses a combination of $\pi/4$ -DQPSK and 8DPSK.

1.1.2 Antenna Details

Ant. No.	Туре	Connector	Gain (dBi)	Remark
1	Chip	N/A	0	

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	5Vdc from host
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1.1.4 Accessories

N/A

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1.1.5 Channel List

	Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	
0	2402	20	2422	40	2442	60	2462	
1	2403	21	2423	41	2443	61	2463	
2	2404	22	2424	42	2444	62	2464	
3	2405	23	2425	43	2445	63	2465	
4	2406	24	2426	44	2446	64	2466	
5	2407	25	2427	45	2447	65	2467	
6	2408	26	2428	46	2448	66	2468	
7	2409	27	2429	47	2449	67	2469	
8	2410	28	2430	48	2450	68	2470	
9	2411	29	2431	49	2451	69	2471	
10	2412	30	2432	50	2452	70	2472	
11	2413	31	2433	51	2453	71	2473	
12	2414	32	2434	52	2454	72	2474	
13	2415	33	2435	53	2455	73	2475	
14	2416	34	2436	54	2456	74	2476	
15	2417	35	2437	55	2457	75	2477	
16	2418	36	2438	56	2458	76	2478	
17	2419	37	2439	57	2459	77	2479	
18	2420	38	2440	58	2460	78	2480	
19	2421	39	2441	59	2461			

1.1.6 Test Tool and Duty Cycle

Test Tool	ISRT, Ver. 2.1.25.4149
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1.1.7 Power Setting

Modulation Mode	Test Frequency (MHz)			
Wiodulation wiode	2402	2441	2480	
GFSK/1Mbps	0x49	0x49	0x4E	
π/4-DQPSK	0x59	0x59	0x5E	
8DPSK/3Mbps	0x59	0x59	0x5E	

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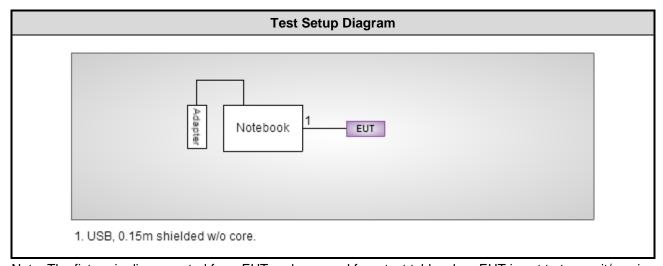


1.2 Local Support Equipment List

	Support Equipment List							
No.	Equipment	Brand	Model	FCC ID	Signal cable / Length (m)			
1	Notebook	DELL	Latitude E6430	DoC	USB, 0.15m shielded w/o core			
2	Fixture							

Note: No.2 and USB cable were provided by applicant.

1.3 Test Setup Chart



Note: The fixture is disconnected from EUT and removed from test table when EUT is set to transmit/receive continuously

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1.4 The Equipment List

Test Item	Conducted Emission	Conducted Emission							
Test Site	Conduction room 1 / (Conduction room 1 / (CO01-WS)							
Instrument	Manufacturer Model No. Serial No. Calibration Date Calibration Until								
Receiver	R&S	ESR3	101657	Jan. 15, 2015	Jan. 14, 2016				
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 17, 2014	Nov. 16, 2015				
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 26, 2014	Nov. 25, 2015				
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Dec. 31, 2014	Dec. 30, 2015				
50 ohm terminal (Support Unit)	NA	50	04	Apr. 15, 2015	Apr. 14, 2016				
Measurement Software	AUDIX	e3	6.120210k	NA	NA				
Note: Calibration Interval of instruments listed above is one year.									

Test Item	Radiated Emission	Radiated Emission					
Test Site	966 chamber 2 / (03C	H02-WS)					
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until		
Spectrum Analyzer	R&S	FSV40	101499	Dec. 31, 2014	Dec. 30, 2015		
Receiver	R&S	ESR3	101657	Jan. 15, 2015	Jan. 14, 2016		
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-524	Oct. 05, 2015	Oct. 04, 2016		
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Oct. 07, 2015	Oct. 06, 2016		
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 10, 2014	Nov. 09, 2015		
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 10, 2014	Nov. 09, 2015		
Preamplifier	Burgeon	BPA-530	100218	Nov. 10, 2014	Nov. 09, 2015		
Preamplifier	Agilent	83017A	MY39501309	Sep. 22, 2015	Sep. 21, 2016		
Preamplifier	EMC	EMC184045B	980192	Sep. 01, 2015	Aug. 31, 2016		
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 16, 2014	Dec. 15, 2015		
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 16, 2014	Dec. 15, 2015		
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 16, 2014	Dec. 15, 2015		
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Dec. 16, 2014	Dec. 15, 2015		
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-004	Dec. 16, 2014	Dec. 15, 2015		
Measurement Software	AUDIX	e3	6.120210g	NA	NA		
Note: Calibration Inter	rval of instruments listed	d above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA

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1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247 FCC Public notice DA 00-705 ANSI C63.10-2013

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	±34.134 Hz
Conducted power	±0.808 dB
Power density	±0.463 dB
Conducted emission	±2.670 dB
AC conducted emission	±2.92 dB
Radiated emission ≤ 1GHz	±3.62 dB
Radiated emission > 1GHz	±5.6 dB

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2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	23°C / 59%	Peter Lin
Radiated Emissions	03CH02-WS	22°C / 66%	Mark Liao
RF Conducted	TH01-WS	23°C / 65%	Alex Huang

FCC site registration No.: 657002IC site registration No.: 10807A-2

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Test Configuration
Conducted Emissions	8DPSK	2441	3Mbps	
Radiated Emissions ≤ 1GHz	8DPSK	2441	3Mbps	
Radiated Emissions > 1GHz	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	
Conducted Output Power	GFSK л/4 QDPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	
Number of Hopping Channels	GFSK 8DPSK	2402~2480 2402~2480	1Mbps 3Mbps	
Hopping Channel Separation	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	
Dwell Time	GFSK 8DPSK	2402 2402	1Mbps 3Mbps	

NOTE: The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** results were found as the worst case and were shown in this report.

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3 Transmitter Test Results

3.1 Conducted Emissions

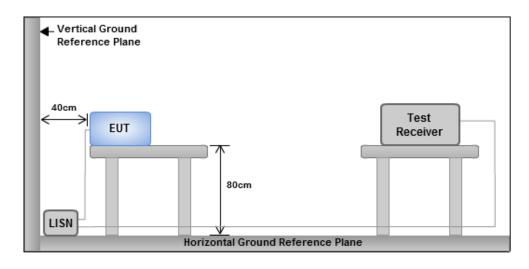
3.1.1 Limit of Conducted Emissions

	Conducted Emissions Limit	
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarith	m of the frequency.	

3.1.2 Test Procedures

- 1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
- 2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
- 3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
- 4. This measurement was performed with AC 120V/60Hz

3.1.3 Test Setup



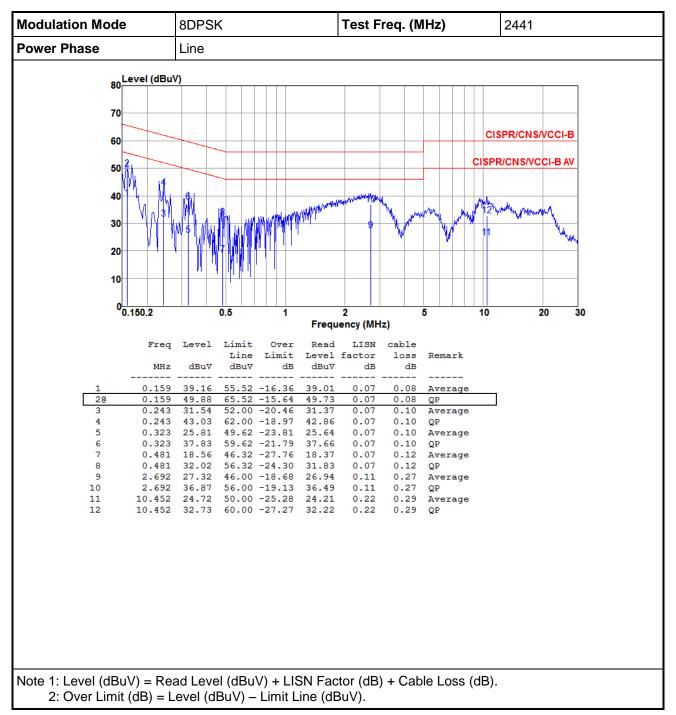
Note: 1. Support units were connected to second LISN.

Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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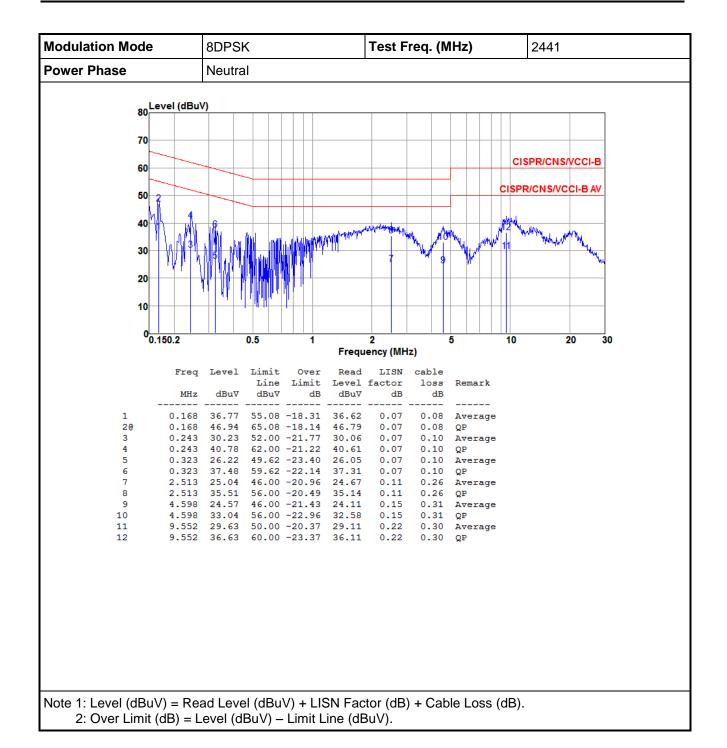


3.1.4 Test Result of Conducted Emissions



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3.2 Unwanted Emissions into Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

	Restricted Band	Emissions Limit	
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit **Note 2**:

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

- 1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
- 2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- 3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

- 1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
- 2. Radiated emission above 1GHz / Peak value RBW=1MHz, VBW=3MHz and Peak detector

Radiated emission above 1GHz / Average value for harmonics

The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula for DH5 packet type which has worst duty factor:

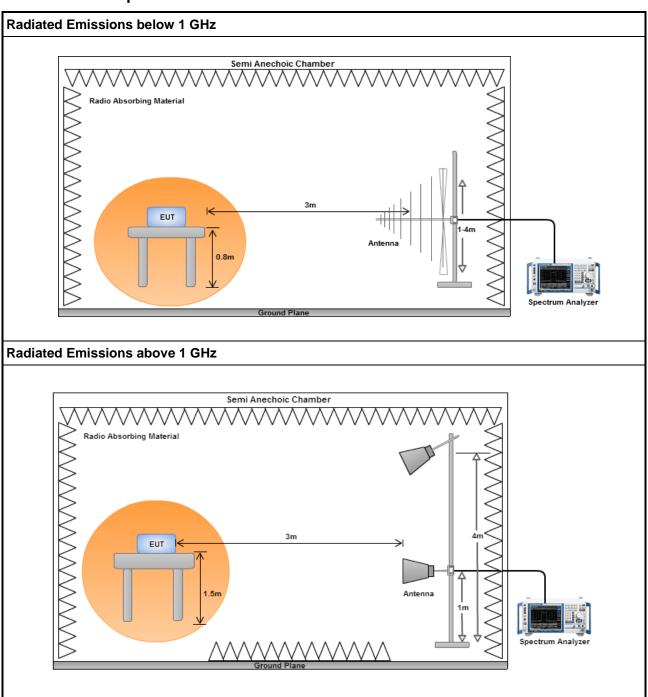
3.
$$20\log \text{ (Duty cycle)} = 20\log \frac{1\text{s} / 1600 * 5}{100 \text{ ms}} = -30.1 \text{dB}$$

4. Radiated emission above 1GHz / Average value for other emissions RBW=1MHz, VBW=1/T and Peak detector

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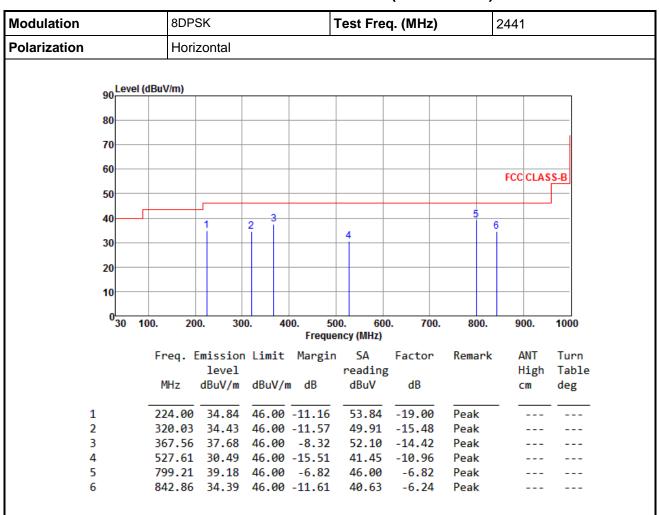
3.2.3 Test Setup



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3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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Modulation	8	BDPS	K		7	Test Fre	q. (MHz)		2441	
Polarization	١	√ertic	cal		•					
90 Le	evel (dBuV/r	n)								$\overline{}$
80—										
00										
70		-								
60										
00									FCC CLAS	S-B
50										
40			1					5	6	
						4				
30			2	3		4				
20										
10										
030	100.	200). 30	0 4	00. 50	0. 60	0. 700.	800.	900.	1000
30	100.	200). 30	0. 4		ncy (MHz)	u. <i>1</i> 00.	800.	900.	1000
	Fre	a F	mission	limit	Margin		Factor	Remark	ANT	Turn
		4	level	2220	1101 6211	reading		ricinal it	High	Table
	MH	Z	dBuV/m	dBuV/ı	n dB	dBuV	dB		cm	deg
1		.79	28.33		-11.67	45.72		Peak		
2		.00	26.91		-19.09	45.91		Peak		
3 4					-18.93 -16.63	41.49	-14.42 -10.37	Peak Peak		
5		.27			-4.49	48.35	-6.84	OP Peak	150	144

43.98

-6.26

Peak

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

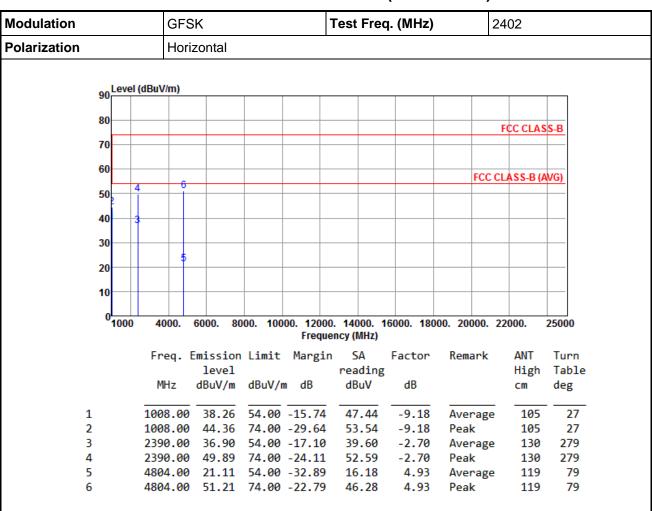
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

840.92 37.72 46.00 -8.28

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3.2.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for GFSK



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

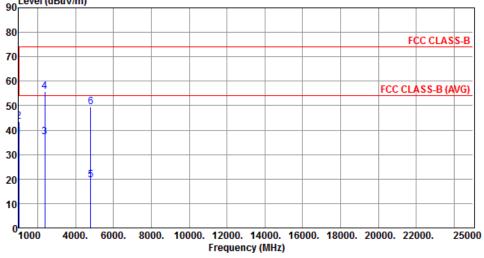
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

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Modulation	GFSK	Test	Test Freq. (MHz)				2402			
Polarization		Vertical								
90	Level (dBu	V/m)								
90	Level (dBu	V/m)								

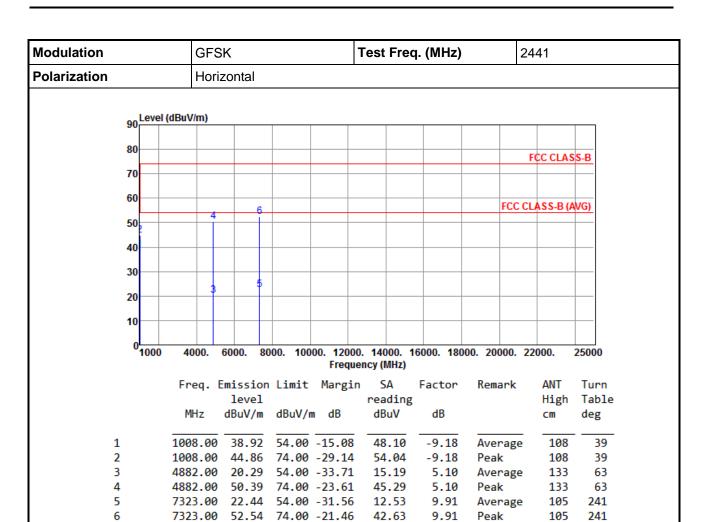


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1000 00	27.26	<u></u>	16.64	AC EA	0.10	A	155	141
1	1008.00	37.36	54.00	-10.64	46.54	-9.18	Average	155	141
2	1008.00	43.37	74.00	-30.63	52.55	-9.18	Peak	155	141
3	2390.00	37.12	54.00	-16.88	39.82	-2.70	Average	100	184
4	2390.00	55.86	74.00	-18.14	58.56	-2.70	Peak	100	184
5	4804.00	19.48	54.00	-34.52	14.55	4.93	Average	270	20
6	4804.00	49.58	74.00	-24.42	44.65	4.93	Peak	270	20

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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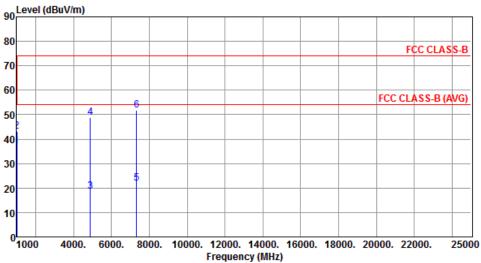
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	GFSK	Test	Freq. (MHz)	2441		
Polarization	Vertical					
90 Level (dBu	V/m)					



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
	4000 00			46.70					
1	1008.00	37.21	54.00	-16./9	46.39	-9.18	Average	145	166
2	1008.00	43.22	74.00	-30.78	52.40	-9.18	Peak	145	166
3	4882.00	18.74	54.00	-35.26	13.64	5.10	Average	101	66
4	4882.00	48.84	74.00	-25.16	43.74	5.10	Peak	101	66
5	7323.00	21.76	54.00	-32.24	11.85	9.91	Average	109	69
6	7323.00	51.86	74.00	-22.14	41.95	9.91	Peak	109	69

*Factor includes antenna factor, cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation			GF	SK		-	Test Fred	q. (MHz)		2480	
Polarization			Hor	izontal		1			1		
	90 L	evel	(dBuV/m)								
	80-										
	80									FCC CLAS	S-B
	70										
	60	_									
	ŀ		4 - 6		3				FCC	CLASS-B (A	WG)
	50										
	40		3								
	20										
	30			. 7	,						
	20	_									
	10										
	10										
	0 <mark>L</mark>	000	4000.	6000.	3000. 100	000. 12000). 14000. 1	16000. 180	00. 20000.	22000.	25000
							ency (MHz)				
			Freq.	Emissio	n Limit	Margin	SA	Factor	Remark	ANT	Turn
				level			reading			High	Table
			MHz	dBuV/n	dBuV/	m dB	dBuV	dB		cm	deg
1	ı		1008.00	38.66	54 00	-15.34	47.84	-9.18	Average	106	46
	2		1008.00			-29.33	53.85	-9.18	Peak	106	46
	3		2483.56			-17.20	39.17	-2.37	Average		279
4	1		2483.50	51.62	74.00	-22.38	53.99	-2.37	Peak	126	279
	5		4960.00	20.12	54.00	-33.88	14.85	5.27	Average	110	84
	-										

44.95

5.27

10.14

10.14

Peak

Peak

Average

84

249

249

110

108

108

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

4960.00 50.22 74.00 -23.78

7440.00 23.61 54.00 -30.39 13.47 7440.00 53.71 74.00 -20.29 43.57

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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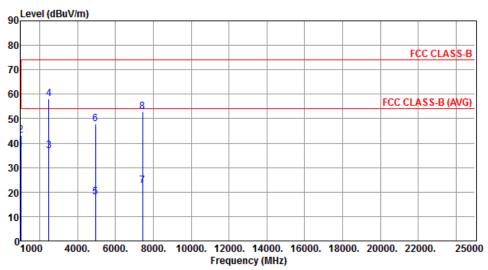
Report Version: Rev. 01

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7



Modulation GI	SFSK	Test Freq. (MHz)	2480
Polarization Ve	/ertical		



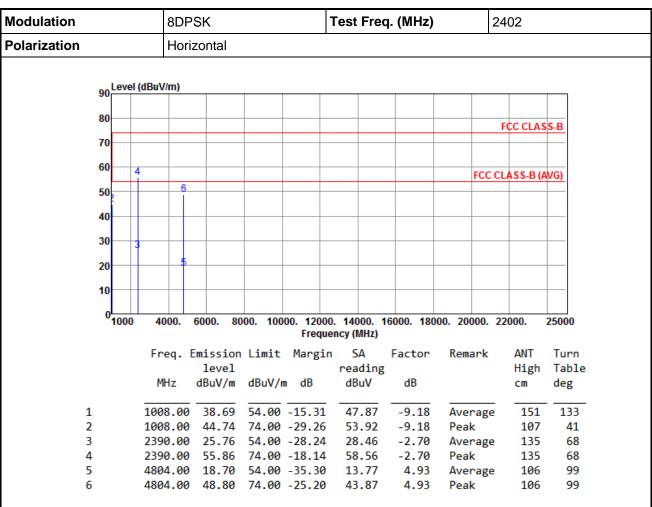
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	1008.00	37.22	54.00	-16.78	46.40	-9.18	Average	144	124
2	1008.00	43.11	74.00	-30.89	52.29	-9.18	Peak	144	124
3	2483.50	36.85	54.00	-17.15	39.22	-2.37	Average	100	186
4	2483.50	58.08	74.00	-15.92	60.45	-2.37	Peak	100	186
5	4960.00	17.87	54.00	-36.13	12.60	5.27	Average	116	78
6	4960.00	47.97	74.00	-26.03	42.70	5.27	Peak	116	78
7	7440.00	22.69	54.00	-31.31	12.55	10.14	Average	110	140
8	7440.00	52.79	74.00	-21.21	42.65	10.14	Peak	110	140

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.2.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 8DPSK



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

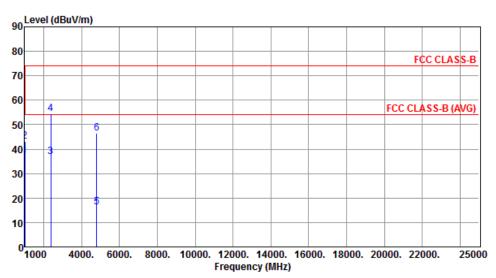
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

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Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Vertical		



		Emission level			SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
_									
1	1008.00	37.27	54.00	-16./3	46.45	-9.18	Average	104	22
2	1008.00	43.32	74.00	-30.68	52.50	-9.18	Peak	104	22
3	2390.00	37.01	54.00	-16.99	39.71	-2.70	Average	100	185
4	2390.00	54.63	74.00	-19.37	57.33	-2.70	Peak	100	185
5	4804.00	16.25	54.00	-37.75	11.32	4.93	Average	103	110
6	4804.00	46.35	74.00	-27.65	41.42	4.93	Peak	103	110

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation			8DF	PSK				Т	est F	req.	(МН	z)	2	2441	
Polarization			Hori	izontal											
	90 <mark>L€</mark>	evel (dBu\	//m)												
	80-													F00.01	
	70													FCC CL/	422-B
	60				6								FCC	CLASS-B	(AVG)
	50		4												(1100)
	40		+												
	30		++										_		
	20				+								_		
	10														
	010	000 4	000.	6000.	8000	. 100					000. 1	8000.	20000.	22000.	25000
			eq. IHz	Emissi leve dBuV/	1		Mar	gin	SA SA read: dBu\	ing	Facto dB	r Re	emark	ANT High	Turn h Table deg

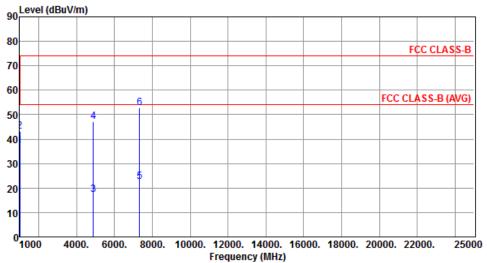
	MHZ	aBuV/m	agns/w ag	aBuV	ав		cm	deg
1	1008.00	38.66	54.00 -15.34	47.84	-9.18	Average	109	42
2	1008.00	44.97	74.00 -29.03	54.15	-9.18	Peak	109	42
3	4882.00	18.48	54.00 -35.52	13.38	5.10	Average	130	80
4	4882.00	48.58	74.00 -25.42	43.48	5.10	Peak	130	80
5	7323.00	23.14	54.00 -30.86	13.23	9.91	Average	127	201
6	7323.00	53.24	74.00 -20.76	43.33	9.91	Peak	127	201

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Vertical		
Lovel (dBu)	(Im)		



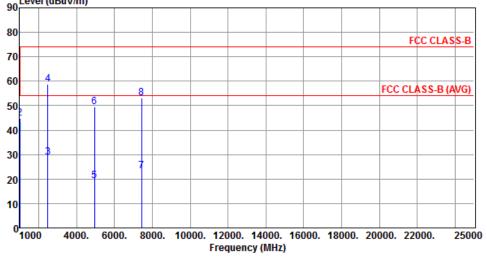
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		CM	deg
1	1008.00	37.27	54.00	-16.73	46.45	-9.18	Average	141	139
2	1008.00	43.22	74.00	-30.78	52.40	-9.18	Peak	141	139
3	4882.00	17.19	54.00	-36.81	12.09	5.10	Average	132	104
4	4882.00	47.29	74.00	-26.71	42.19	5.10	Peak	132	104
5	7323.00	22.64	54.00	-31.36	12.73	9.91	Average	144	188
6	7323.00	52.74	74.00	-21.26	42.83	9.91	Peak	144	188

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation		8DPSK			Test	Freq.	(MHz)	Test Freq. (MHz)			
Polarization		Horizontal									
90	Level (dBu	V/m)									
90	Level (dBu	V/m)									



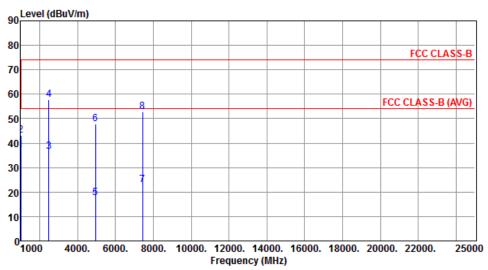
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1008.00	38.94	54.00	-15.06	48.12	-9.18	Average	106	51
2	1008.00	44.87	74.00	-29.13	54.05	-9.18	Peak	106	51
3	2483.50	28.76	54.00	-25.24	31.13	-2.37	Average	100	69
4	2483.50	58.86	74.00	-15.14	61.23	-2.37	Peak	100	69
5	4960.00	19.26	54.00	-34.74	13.99	5.27	Average	116	79
6	4960.00	49.36	74.00	-24.64	44.09	5.27	Peak	116	79
7	7440.00	23.11	54.00	-30.89	12.97	10.14	Average	105	63
8	7440.00	53.21	74.00	-20.79	43.07	10.14	Peak	105	63

*Factor includes antenna factor, cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1008.00	37.11	54.00	-16.89	46.29	-9.18	Average	149	139
2	1008.00	43.22	74.00	-30.78	52.40	-9.18	Peak	149	139
3	2483.50	36.43	54.00	-17.57	38.80	-2.37	Average	104	181
4	2483.50	57.90	74.00	-16.10	60.27	-2.37	Peak	104	181
5	4960.00	17.71	54.00	-36.29	12.44	5.27	Average	166	85
6	4960.00	47.81	74.00	-26.19	42.54	5.27	Peak	166	85
7	7440.00	22.77	54.00	-31.23	12.63	10.14	Average	108	157
8	7440.00	52.87	74.00	-21.13	42.73	10.14	Peak	108	157

*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.3.2 Test Procedures

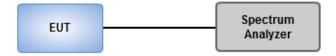
Reference Level Measurement

- Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
- Set Sweep time = auto couple, Trace mode = max hold.
- 3. Allow trace to fully stabilize.
- 4. Use the peak marker function to determine the maximum amplitude level.

Unwanted Emissions Level Measurement

- 1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
- 2. Trace Mode = max hold, Sweep = auto couple.
- 3. Allow the trace to stabilize.
- 4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

3.3.3 Test Setup

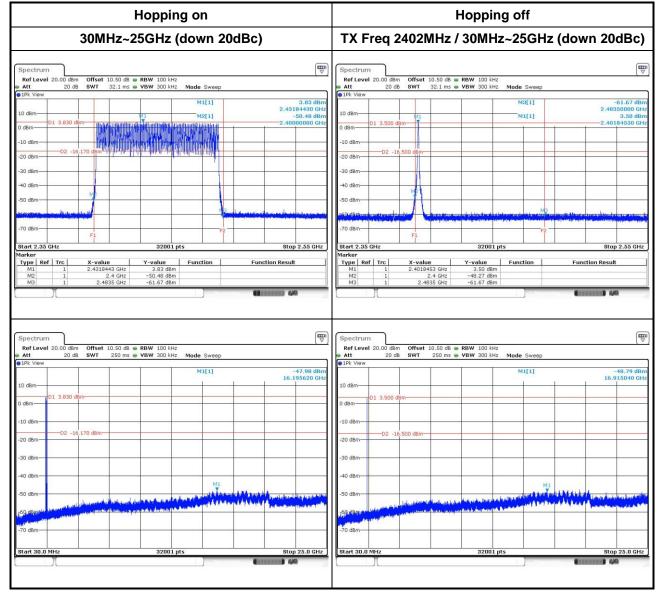


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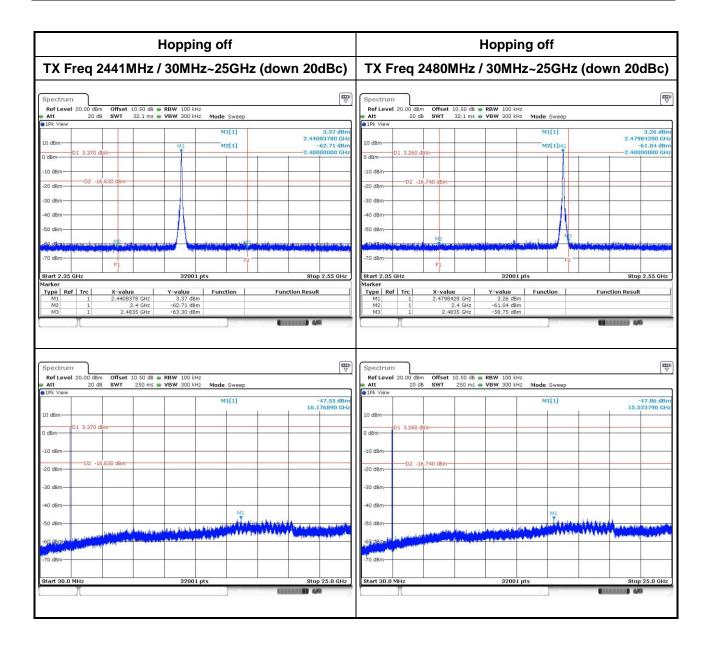
3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands

GFSK



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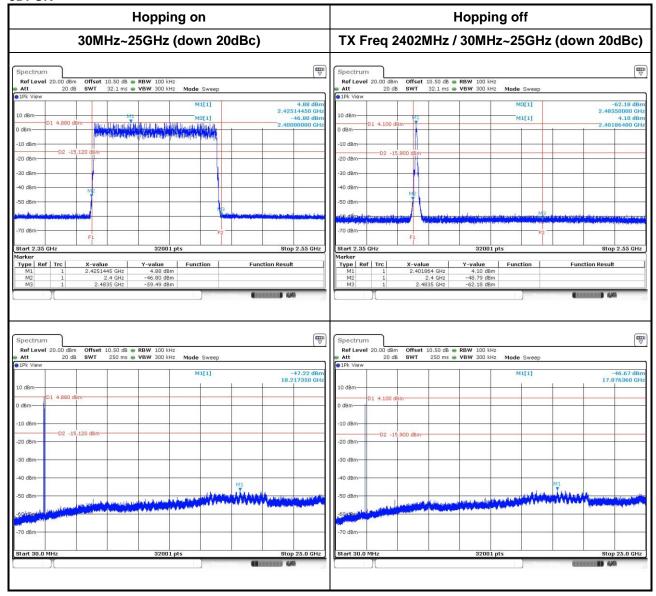




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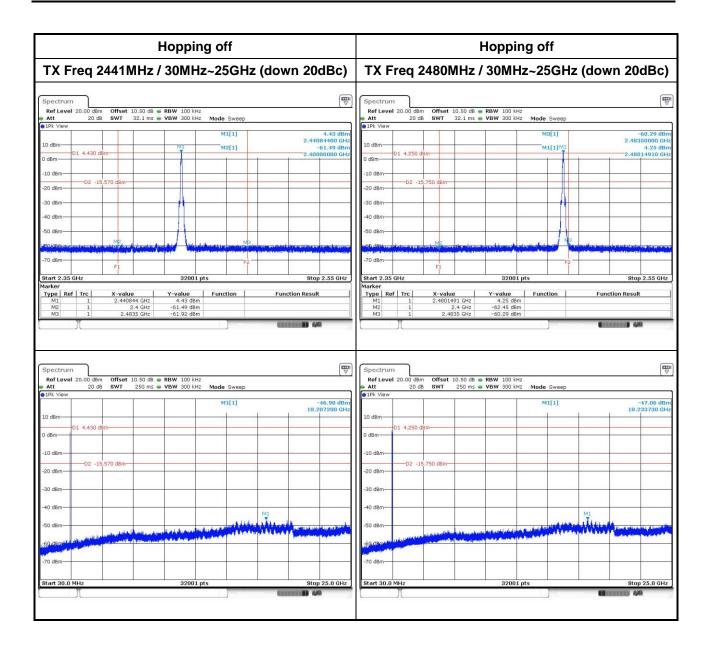


8DPSK



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3.4 Conducted Output Power

3.4.1 Limit of Conducted Output Power

1 Watt For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band.
0.125 Watt For all other frequency hopping systems in the 2400–2483.5 MHz band.
0.125 Watt For Frequency hopping systems operating in the 2400–2483.5 MHz band have hopping channel carrier frequencies that are separated by two-thirds of the 20 dB bandwidth of the hopping channel.

3.4.2 Test Procedures

- A wideband power meter is used for power measurement. Bandwidth of power senor and meter is 50MHz
- 2 If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.4.3 Test Setup



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3.4.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
GFSK	2402	2.88	4.59	125
GFSK	2441	2.88	4.59	125
GFSK	2480	2.90	4.63	125
л/4 DQPSK	2402	3.48	5.41	125
л/4 DQPSK	2441	3.44	5.36	125
л/4 DQPSK	2480	3.42	5.34	125
8DPSK	2402	3.64	5.61	125
8DPSK	2441	3.66	5.63	125
8DPSK	2480	3.51	5.45	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
GFSK	2402	2.50	3.98
GFSK	2441	2.50	3.98
GFSK	2480	2.51	3.99
л/4 DQPSK	2402	2.51	3.99
л/4 DQPSK	2441	2.51	3.99
л/4 DQPSK	2480	2.51	3.99
8DPSK	2402	2.50	3.98
8DPSK	2441	2.51	3.99
8DPSK	2480	2.50	3.98

Note: Average power is for reference only.

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3.5 Number of Hopping Frequency

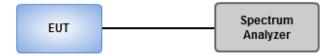
3.5.1 Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

3.5.2 Test Procedures

- 1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
- 2 Allow trace to stabilize.

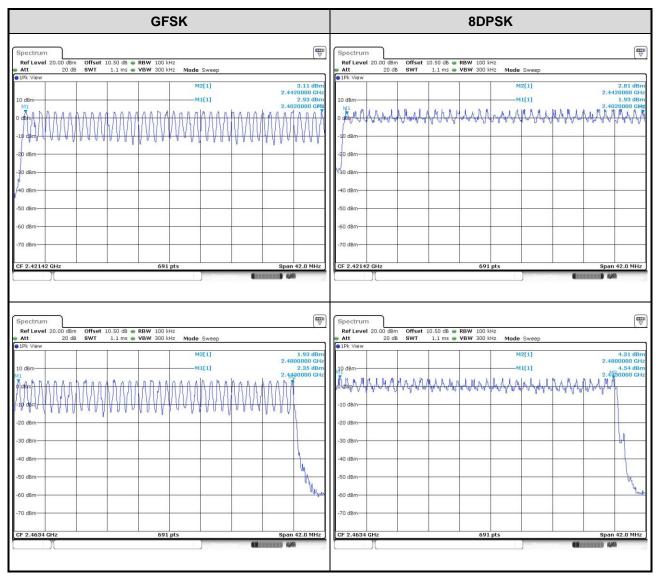
3.5.3 Test Setup



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3.5.4 Test Result of Number of Hopping Frequency



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3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

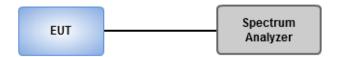
20dB Bandwidth

- 1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak, Trace max hold
- 2 Allow trace to stabilize
- 3 Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

- Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Sample, Trace max hold
- 2 Allow trace to stabilize
- 3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup

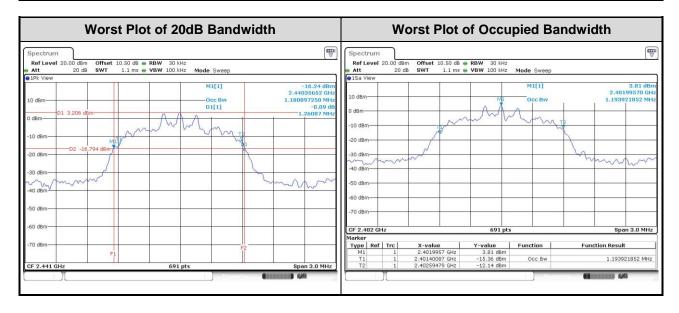


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3.6.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK	2402	0.987	0.903
GFSK	2441	0.957	0.890
GFSK	2480	0.939	0.890
8DPSK	2402	1.257	1.194
8DPSK	2441	1.261	1.181
8DPSK	2480	1.261	1.181



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3.7 Channel Separation

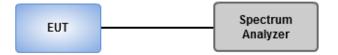
3.7.1 Limit of Channel Separation

- Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
- Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.7.2 Test Procedures

- Set RBW=100kHz, VBW=300kHz, Sweep time = Auto, Detector=Peak, Trace max hold
- 2 Allow trace to stabilize
- 3 Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

3.7.3 Test Setup

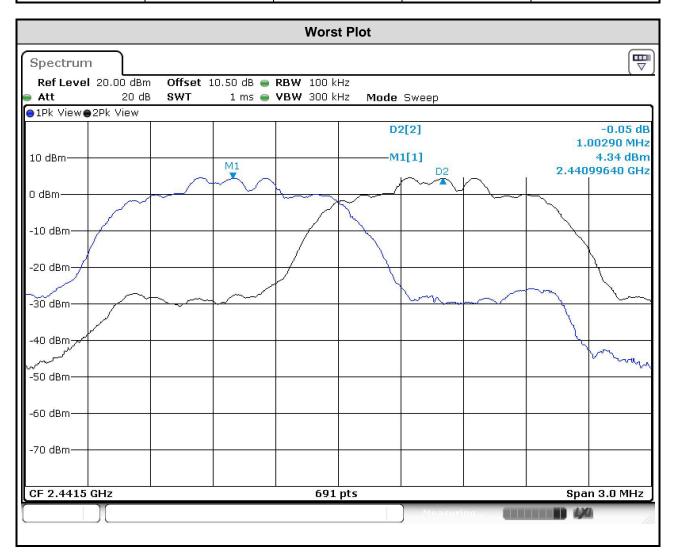


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3.7.4 Test result of Channel Separation

Modulation Mode	Freq. (MHz)	Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)
GFSK	2402	1.003	0.987	0.658
GFSK	2441	1.003	0.957	0.638
GFSK	2480	1.003	0.939	0.626
8DPSK	2402	1.003	1.257	0.838
8DPSK	2441	1.003	1.261	0.841
8DPSK	2480	1.003	1.261	0.841



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3.8 Number of Dwell Time

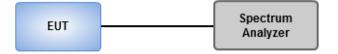
3.8.1 Limit of Dwell time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.8.2 Test Procedures

- 1. Set RBW=100kHz,VBW=300kHz,Sweep time = 500us(DH1),2ms(DH3),4ms(DH5), Detector=Peak, Span=0Hz,Trace max hold
- 2 Enable gating and trigger function of spectrum analyzer to measure burst on time.
- 3. The DH1 packet can cover a single time slot. A maximum length packet has duration of 1 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 1/1600 seconds, or 0.625ms. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
- 4. The DH3 packet can cover up to 3 time slots. A maximum length packet has duration of 3 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 3/1600 seconds, or 1.875ms. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
- The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds

3.8.3 Test Setup

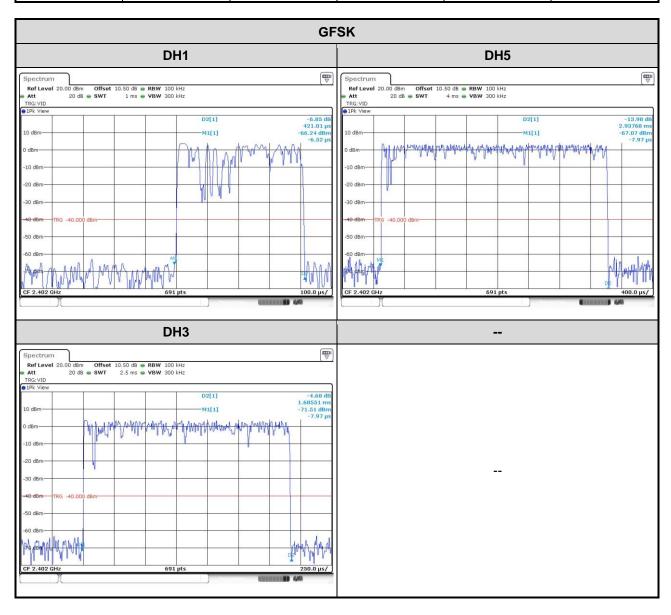


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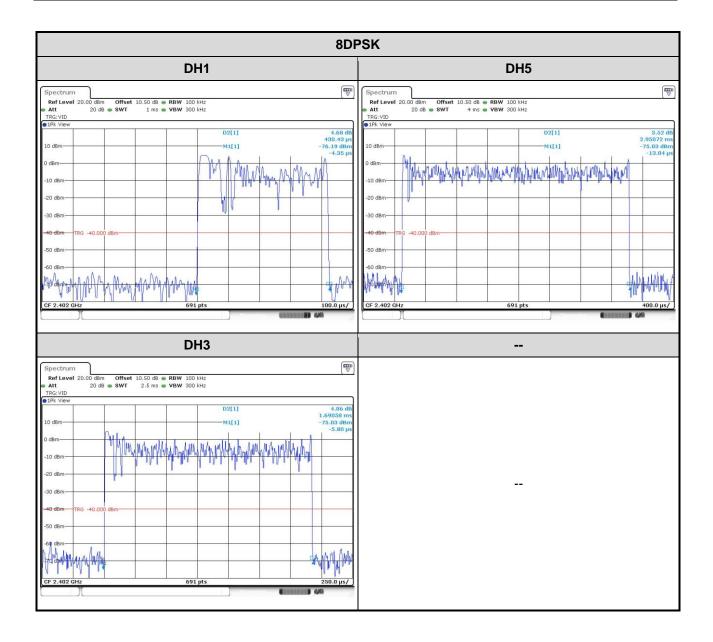
3.8.4 Test Result of Dwell Time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 31.6 (79 Hopping*0.4)	Result (s)	Limit (s)
GFSK-DH1	2402	0.42101	320	0.135	0.4
GFSK-DH3	2402	1.68551	160	0.270	0.4
GFSK-DH5	2402	2.93768	106.6	0.313	0.4
8DPSK-DH1	2402	0.43043	320	0.138	0.4
8DPSK-DH3	2402	1.69058	160	0.270	0.4
8DPSK-DH5	2402	2.95072	106.6	0.315	0.4



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4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website http://www.icertifi.com.tw.

Linkou

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R.O.C.

Kwei Shan

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Tel: 886-3-271-8640

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If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666 Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

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